## Response of Rat Spinal Cord to Microbeam Irradiation

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**Introduction**: Microbeam Radiation Therapy (MRT) research at both the National Synchrotron Light Source (NSLS) at Brookhaven National Laboratory and the European Synchrotron Radiation Facility (ESRF), Grenoble, France, has been primarily focused on the central nervous system (CNS). The aim of these research programs is to improve the treatment of neoplasms of the CNS. A standard and frequently used animal model used to evaluate radiation effects on normal CNS is the rat spinal cord. The radiation-induced damage seen in the spinal cord and the brain are similar, but the end points for the spinal cord are more clearly defined. Described below is a preliminary study carried out at the X17B1 beamline at the NSLS. The objective was to compare the radiation effects from single-fraction, unidirectional microbeam and broad beam irradiation using beams of the same spectral energy.

**Methods and Materials**: Male Fischer 344 rats aged 12 weeks received single exposure irradiation using an array of microplanar x-ray beams of 80 μm width and of 300 or 400 μm center-to-center beam spacings. The irradiation field was located on the cervical spine and encompassed a 7-mm length of spinal cord. Synchrotron broad-beam (unsegmented) irradiations were carried for comparison. All microbeam irradiations were done with the rats positioned between two 5.1-cm thick acrylic slabs, one upstream and one downstream, to simulate tissue depth in human irradiations. A total of 47 rats were used in the study. Animals were monitored for 12 months after irradiation, at which time the "Rotor Rod" test was carried out to detect potential neurological dysfunction.

**Results**: The microbeam doses used were 150 and 225 Gy with a 300 μm center-to-center beam spacing, and 150, 225, 300, 600 Gy with a 400 μm center-to-center spacing. Broad-beam single-exposure doses were 25, 50 and 75 Gy. In the case of rats irradiated with the microbeam modality there was no evidence of myeloparesis at one year after irradiation, even after doses as high as 600 Gy. However, after broad beam irradiation, myeloparesis was evident in the 50 Gy (100%) and 75 Gy (100%) dose groups. The Rotor-Rod test did not reveal any evidence of neurological dysfunction in the case of rats irradiated with microbeams, but there was evidence of considerable neurological impairment after broad beam irradiation.

**Conclusions**: It was concluded that the rat spinal cord exhibited an extremely high tolerance to microbeam irradiation.

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